(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 February 2001 (15.02.2001)

PCT

(10) International Publication Number
WO 01/11899 A1

(51) International Patent Classification[7]: H04Q 1/24

(21) International Application Number: PCT/SE00/01542

(22) International Filing Date: 4 August 2000 (04.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9902877-1 11 August 1999 (11.08.1999) SE

(71) Applicant *(for all designated States except US)*: ALLGON AB [SE/SE]; Antennvägen 6, S-187 80 Täby (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: GAMALIELSSON, Jonas [SE/SE]; Rotegatan 2D, S-541 40 Skövde (SE). YI-DONG HU, Annika [SE/SE]; Bivägen 103, S-184 38 Åkersberga (SE). LARSSON, Iréne [SE/SE]; Dalagatan 8, S-111 23 Stockholm (SE). EDVARDSSON, Olov [SE/SE]; Sandbrovägen 30A, S-183 30 Täby (SE).

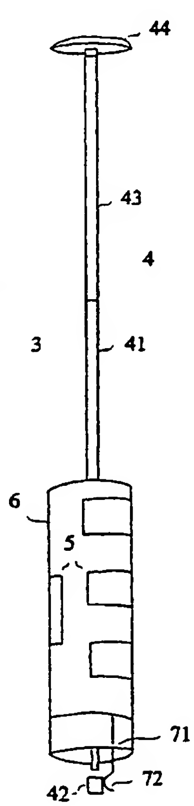
(74) Agent: EHRNER & DELMAR PATENTBYRÅ AB; Box 103 16, Gumshornsgatan 7, S-100 55 Stockholm (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: DUAL BAND ANTENNA DEVICE



(57) Abstract: An antenna device for transmitting and/or receiving RF signals within each of first and second frequency bands and a radio communication device including such an antenna device. The antenna device (3) comprises a feed means (42, 71, 72, 53, 54) and an antenna whip (4), arranged to slide into and out of the telephone to retracted and extended positions. The antenna whip includes a radiating structure (41) comprising a first radiating element (45) and a second radiating element (46, 46', 46''), tuned for operation in a first and a second frequency band. The first radiating element (45) and the second radiating element (46, 46', 46'') extend conjointly along a major portion of the second radiating element (46, 46', 46''), along which portion both the first radiating element (45) and the second radiating element (46, 46', 46'') are arranged to be radiating.

WO 01/11899 A1

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DUAL BAND ANTENNA DEVICE

FIELD AND BACKGROUND OF THE INVENTION

The invention relates to an antenna device, for transmitting and/or receiving RF signals within each of first and second frequency bands, which includes an extendable radiating structure. Specifically, it relates to a dual band antenna device for a mobile radio communication device, e.g., a hand-portable telephone, which is capable of both transmitting and receiving on two separate frequency bands. This increases the probability of the telephone being operable for communication in a site where service is available within more than one band. Such a telephone may be a terminal in, e.g., a GSM, PCN, DECT, AMPS, PCS, W-CDMA, Korean PCS or PDC cellular telephone system, possibly having an additional pager function or other radio facilities. In the specification and claims the words "dual band" should, as a general rule, be understood as "operating within at least two frequency bands". Also, when referring to two frequency bands or similar, it could include generally at least two frequency bands. The frequencies included in the dual or multiple bands of the invention do not need to have any fixed relationship to one another and may thus have arbitrary separations.

PRIOR ART

In the past, antenna means including a helical element in combination with an extendable whip antenna have been used for hand-portable cellular telephones in order to achieve compact dimensions and durability while maintaining high efficiency in call mode. One feature of a resonant antenna in general is that it is operable within one fundamental frequency band and

within higher frequency bands, but only those having a fixed and predetermined relation to the fundamental frequency band. The ranges of higher frequency bands depend on, inter alia, antenna geometry. An inherent, higher frequency band may not appear where desired for a given geometry of a radiator.

In a radio device, such as a personal telephone, it is advantageous to achieve an antenna means that has an effective radiation distribution and a high degree of efficiency. The telephone may preferably function in different operating modes. Two different operating modes are a stand-by mode and a call (talk) mode. In these two operating modes there are different demands upon the antenna means. For example, if the telephone is carried in the stand-by mode, the carrier (a person) may require a small-size and compact configuration of the telephone. An antenna means extending too far from the telephone may be inconvenient in this case.

The reception and transmission performance of an antenna means depends not only on the antenna means itself, but also on a radiation path between the telephone and a base station. Obstacles in the radiation path will lower the communication performance of the antenna. In personal telephones it is important that the body of the user does not excessively obstruct the radiation path. Therefore, an antenna means extending sufficiently far from the housing of the telephone is desirable in the call mode when demands for performance are higher. Also, antennas extending at least about a quarter wavelength from the telephone tend to be generally more efficient.

Dual band antennas, having a helical or meander standby antenna with two radiating elements, through which a rod

antenna is slidably arranged, have been provided. The rod antenna comprises a straight radiator operating as a half wavelength antenna in the higher frequency band and as a quarter wavelength antenna in the lower frequency band. This requires that the relation between the frequency bands is approximately 1:2. Further, the tuning of the rod antenna for the two bands can have a complicated relation. The matching of the rod antenna can also be somewhat complicated since different antenna types are to be matched, i.e. combinations of retracted/extended rod in talk position/free space. WO-A1-97/49141 and WO-A1-97/30489 are examples of patent applications where such antenna applications are included.

WO, A1, 99/26314 and WO, A1, 99/26315 each discloses a dual band antenna including a rod antenna, which comprises two antenna elements, operating in a first and a second frequency band, respectively. Those rod antennas are relatively long, since the radiating portions of the respective antenna elements and a coupling region are located after each other along the length of the rod. Also the manufacture of the antenna appears to be complicated due to the use of different layers and a spacer.

Multi band rod antennas are also known, where two straight radiators are located after each other along the length of the rod, and the radiators being connected via a resonance circuit, whereby one radiator operates in the higher frequency band and both radiators operate in the lower frequency band. Such antennas are disclosed in EP, A2, 0 896 384 and EP, A2, 0 814 536. Since the two straight radiators and the resonance circuit are located after each other along the length of the rod, those rod antennas are relatively long.

In the rod antennas above, having radiating elements and possibly components located in a row after each other, there will be a big difference in bending properties along the length of the rod. This can be a special problem if it occurs in a center portion of the rod where the moment arm is at maximum, and it could break due to indications of fracture. The tuning of such antennas appears to be quite complicated when two radiating elements coupled in series shall be tuned for two frequencies.

Other types of rod antennas including more than one radiating element are known from for example US, A, 3 550 145, US, A, 3 541 567, and WO, A1, 97/12417. All those antennas are designed as broad band antennas. Further, they are neither extendable/retractable nor arranged to be used in an antenna device including a further radiating structure.

Further types of rod antennas including more than one radiating element are known from for example US, A, 4 138 681, and US, A, 5 907 307. These antennas are designed as single band antennas. Further, neither are any provisions made for designing these to be extendable/retractable nor are they arranged to be used in an antenna device including a further radiating structure.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an antenna means, for transmitting and/or receiving RF signals within each of first and second frequency bands, including a radiating structure which is extendable and retractable, which provides good antenna characteristics, and uses the space efficiently.

These objects are attained by an antenna means according to the appended claims 1-16.

By the features of claim 1, an antenna means of the kind mentioned above, in which the radiating elements of the extendable and retractable radiating structure can be tuned with more freedom, than in prior art antennas. An antenna means having arbitrary separation between the frequency bands can also be obtained. Due to the extra freedom in tuning an antenna device which is simple to match is also obtained.

By the arrangement of the radiating elements coextending it is achieved a durable radiating structure, having good mechanical stability with minimal risk for occurrence of indications of fracture. It is especially advantageous when one radiating element extends along a major portion of the length of the radiating structure.

Through the arrangement of the second radiating element in the upper portion of the radiating structure, an antenna device which radiates from a radiator further away from a telephone then an antenna device having the second radiating element in the lower portion is obtained.

By arranging one dielectric body separating and surrounding the two radiating elements, a mechanically stable antenna device, which can be simple to manufacture is obtained.

By the arrangement of a second radiating structure, advantageous antenna operation in different modes is obtained.

A further object of the invention is to provide a radio communication device including an antenna device having the mentioned features.

This object is obtained by a radio communication device according to the appended claim 17.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows one possible application of an antenna device according to the invention.

Fig. 2 shows the antenna device of figure 1 schematically and enlarged.

Fig. 3 shows schematically, in a longitudinal section, a first embodiment according to the invention of the first radiating structure of figure 1 and 2.

Fig. 4 shows schematically, in a longitudinal section, a second embodiment according to the invention of the first radiating structure of figure 1 and 2.

Fig. 5 shows schematically a third embodiment according to the invention of the first radiating structure of figure 1 and 2.

Fig. 6 shows schematically a fourth embodiment according to the invention of the first radiating structure of figure 1 and 2.

Figure 7 shows schematically an alternative feeding arrangement.

Figure 8 shows a cross section taken at VIII-VIII in figure 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to fig. 1, one possible application of an antenna device according to the invention is shown. A hand portable mobile telephone 1 is provided with an antenna device 3, according to the invention. The antenna device includes an antenna whip 4, which is movable between an extended position and a retracted position, and includes a first radiating structure 41. The figure shows the antenna device with the whip 4 in the extended position. In the retracted position the whip is contained in the housing 2 of the telephone and inside a dielectric essentially cylindrical carrier 6. Only the knob 44, which is a stopper for the retraction movement, is visible from the outside when the whip 4 is in the retracted position. The carrier 6 is provided with an opening through which the whip is slidable. Further the carrier 6 is provided with a second radiating structure 5, which performs the major part of the antenna function when the whip is in its retracted position. The second radiating structure shown can be omitted or have other locations, e.g. inside the telephone.

Figure 2 shows the antenna device 3 of figure 1 schematically and enlarged. The whip 4 includes a radiating first structure 41 having a rod shape, and which will be explained further below. Further, the whip includes a portion 43 of insulating material, which portion preferably has a length corresponding to the height of the second radiating structure 5, so that the first radiating structure 41 is not surrounded by the radiating structure 5 when the whip is in its retracted

position. The portion 43 can be omitted if the second radiating structure 5 has another shape or location not surrounding the whip 4 in retracted position. At the top, the whip 4 is provided with a knob 44, as mentioned above, and at the bottom it is provided with a stopper 42. The stopper 42 has a cross section larger than that of the whip. The movement of the whip to its extended position is stopped when the stopper 42 comes in contact with a device (not shown), provided with an opening allowing the portion 41 of the whip 4 to slide through, but not the stopper 42, and arranged in or on the carrier 6 or the housing 2. The stopper 42 is made of a conductive material and is adapted to contact the feed point 71 via a contact member 72 when the whip antenna 4 is extended, as is shown in fig 2. The feed point 71 is connected to transceiver circuits of the radio communication device. The second radiating structure 5 comprises meandering radiating elements. From the feed point 71, two meandering elements are fed. They are arranged to operate in two frequency bands, one in a higher and one in a lower band, preferably the same as the first radiating structure 4, as will be discussed further below. Alternatively only one meandering element can be present, e.g. for operation in only one band. In a further alternative, the second radiating structure 5 can comprise one or two helical radiators for operation in one or more frequency bands.

For matching of the first 41 and second 5 radiating structures, matching means can be provided on the carrier 6, and being coupled between the feed point 71 and the respective radiating structure.

In figure 3, a first embodiment of the first radiating structure 41 according to the invention is schematically

shown, in a longitudinal section, provided with a stopper in a side view. Lower ends of a first radiating element 45 and a second radiating element 46 are fixed and connected, at the lower end of the radiating structure 41, to the stopper 42. The two radiating elements 45, 46 are fed at the lower end via the stopper 42 and extend in parallel from the lower end towards the upper end of the radiating structure 41. For the tuning of the first radiating element 45 to a first frequency it has been given a length being the length of the radiating structure 41. The second radiating element 46 is tuned to a second frequency and has a length being shorter than the first radiating element 45.

With this configuration the two radiating elements can easily be tuned to their respective frequencies. The first element 45 can e.g. be tuned for operation in the 900 MHz GSM band and the second for operation in the 1800 MHz GSM band. The ratio between the lengths can thus be 2:1.

The first radiating element 45 and the second radiating element 46 are separated with a certain spacing, e.g. about 0.5 mm, by a dielectric 47. Further, the radiating elements 45, 46 are surrounded by a dielectric 47, with a smallest thickness being about e.g. 0.5 mm. Preferably one continuous dielectric body 47 separates and surrounds the two radiating elements 45, 46. With this arrangement, where one radiating element 45 extends along the full length of the radiating structure 41, which is a major portion of the length of the antenna whip 4, a mechanically favourable antenna device is also obtained.

In figure 4, a second embodiment of the first radiating structure 41 according to the invention is schematically

shown, in a longitudinal section, provided with a stopper in a side view. It differs from the embodiment of figure 2 in that the second radiating element 46 extends from the upper end of the radiating structure 41. Only the first radiating element 45 is fed via the stopper 42 at the lower end. The second radiating element 46 is fed capacitively/inductively at its lower end via the second radiating structure 5. The second radiating structure 5, which can include a meander structure or a helical structure can then exhibit an enlarged portion of one radiating element at the coupling region for improving the coupling. Alternatively, the second radiating element 46 can be fed via the first radiating element 45. The two radiating elements 45 then couple to each other capacitively/inductively along the length of the first radiating element 45.

As in the previous embodiment one continuous dielectric body 47 preferably separates and surrounds the two radiating elements 45, 46.

Also the radiating structure of this embodiment has the advantages concerning durability and tuning properties as in the previous embodiment.

A third embodiment of the first radiating structure 41 according to the invention is schematically shown in figure 5. The dielectric material of the radiating structure 41 is only indicated with broken lines, for clarity. The radiating structure 41 includes a central first radiating element 45 attached to, and fed via, the stopper 42. A second radiating element 46' having the shape of a conductive cylinder is concentrically arranged around the first radiating element 45. The two radiating elements 45, 46' both extend from the upper end of the radiating structure 41, and the second radiating

element 46′ has a shorter length than the first radiating element. The second radiating element 46′ is fed capacitively/inductively at its lower end via the second radiating structure 5. The second radiating structure 5, which can include a meander structure or a helical structure can then exhibit an enlarged portion of one radiating element at the coupling region for improving the coupling.

In an alternative of this embodiment, the second radiating element 46′, which has the shape of a conductive cylinder, is attached to, and fed via, the stopper 42. It thus coextends with the first radiating element 45 from the lower end.

Also the radiating structures of those embodiments have the advantages concerning durability and tuning properties as in the previous embodiments.

In figure 6, a fourth embodiment of the first radiating structure 41 according to the invention is schematically shown. The dielectric material of the radiating structure 41 is only indicated with broken lines, for clarity. The radiating structure 41 includes a central first radiating element 45 attached to and fed via the stopper 42. A second radiating element 46′′ having a helical shape is concentrically arranged around the first radiating element 45. Also the second radiating element 46′′ is attached to, and fed via, the stopper 42. The two radiating elements 45, 46′′ both extend from the lower end of the radiating structure 41, and are shown to have the same axial length. However those lengths could be different. Alternatively the helically configured second radiating element 46′′ can be replaced with a meandering element.

In the previous embodiments, the first radiating element 45 is suitable for operation in a lower frequency band, whereas the second radiating element 46, 46′ is suitable for operation in a higher frequency band. In this embodiment, of fig.6 (with alternative) however, the situation is the opposite, and the first radiating element 45 is suitable for a higher frequency band. Hereby a much shorter radiating structure 41 can be obtained, which requires smaller space when retracted into the radio communication device.

Figure 7 shows schematically a feeding arrangement, which is an alternative to the feeding via the stopper 42. Here the radiating elements 51, 52 of the second radiating structure 5 are provided with contact members 53, 54. Those contact members are arranged to contact feed portions of the first 45 and second 46 radiating element, respectively, for feeding via portions of the radiating elements 51, 52 and feed point 71. By this arrangement the first 45 and second 46 radiating element can be made shorter, when tuned to the desired frequency.

In the embodiments above, the cross section of the radiating structure 41 can advantageously be circular, especially when the radiating structure 41 is symmetric. However, when the radiating structure 41 is not symmetric, it is to prefer that the cross section is not circular, in order to guide the whip and prevent rotation around a longitudinal axis. A guiding member of a corresponding cross section is then present in or on the carrier 6 or the housing 2. Such cross section could have the shape of an oval, a triangle, a square, a rectangle, etc. Hereby several advantages can be obtained. The bending properties of the whip 4 due to the unsymmetric radiating structure 41 can be adjusted. The whip can be controlled so

that it always takes the same position in extended position, in relation to the chassis 2. Hereby the radiating elements always take the same position in relation to each other and the chassis 2, and the radiation pattern can be controlled. If the radiating elements 45, 46, 46', 46'' have separated feed portions, the respective feed portion can be guided into contact with the corresponding contact member or coupling portion. In figure 8, a cross section taken at VIII-VIII in figure 1, illustrating a possible cross section of the second radiating structure, is shown. As seen the carrier 6 has been given a corresponding cross section.

It should be noted that in the previous embodiments, both the first radiating element 45 and the second radiating element 46 radiate along their full lengths.

Although the invention has been described in conjunction with a number of preferred embodiments, it is to be understood that various modifications may still be made without departing from the spirit and scope of the invention as defined by the appended claims. One such possible modification is providing the second radiating element 46 to extend a certain distance beyond the upper end of the first radiating element 45.

For obtaining operation in further frequency band (-s). the first structure may include at least one further radiating element at least partially co-extending with the first radiating element 45. The further radiating element (-s) can be a straight radiating element, a helical radiating element, a tubular radiating element or meandering radiating element. The feeding can be provided by galvanic, inductive or capacitive coupling at a feed portion preferably located at one end of the further radiating element (-s).

CLAIMS

1. An antenna device for transmitting and/or receiving RF signals within each of first and second frequency bands, comprising:

- at least one feed means (42, 71, 72, 53, 54) to be coupled to circuitry of a radio communication device, for transferring RF signals between the antenna device (3) and circuits of the radio communication device,
- an elongated radiating first structure (41) having a shape of a rod, a first longitudinal axis and first and second ends,
- said first structure (41) being extendable and retractable and including a first radiating element (45), having third and fourth ends, and a second radiating element (46, 46', 46''), having fifth and sixth ends,
- a first (44) and a second (42) stopper being provided on the first structure (41), limiting a longitudinal movement of the first structure (41) in extended and retracted positions, respectively,
- a coupler for coupling the first structure (41) to transceiver circuits of the radio communication device, whereby
- the first structure (41), when in an extended position, being coupled via said feed means (42, 71, 72, 53, 54) and being operable to transmit and receive RF-signals within each of said first and second frequency bands,

c h a r a c t e r i s e d i n that

- the first radiating element (45) extends from the first end,
- the first radiating element (45) and the second radiating element (46, 46', 46'') extend conjointly along the first

longitudinal axis defining a first portion where the first (45) and second (46, 46', 46'') radiating elements overlap along the first longitudinal axis, along which portion both the first radiating element (45) and the second radiating element (46, 46', 46'') are arranged to be radiating, and

- the first portion has a length along the first longitudinal axis equal to at least a major portion of the extension of the second radiating element (46, 46', 46'') along the first longitudinal axis,
- said conjointly extending first and second radiating elements (46, 46', 46'') having different resonance frequencies.

2. The antenna device according to claim 1, wherein
- the second radiating element (46, 46', 46'') extends from the first end.

3. The antenna device according to claim 1 or 2, wherein said at least one feed means (42, 71, 72, 53, 54) is provided at said first end.

4. The antenna device according to any of claims 1 -3, wherein said first (45) and second (46, 46', 46'') elements are conductively connected in parallel at said at least one feed means (42).

5. The antenna device according to claim 1 or 2, wherein said at least one feed means (42, 71, 72, 53, 54) is provided at said second end.

6. The antenna device according to claim 5, wherein the second radiating element (46, 46', 46'') is fed at a second feed means located between said first and second ends.

7. The antenna device according to any preceding claim, wherein the first radiating element (45) and the second radiating element (46, 46', 46'') are separated and surrounded by one continuous dielectric body (47).

8. The antenna device according to any preceding claim, wherein said first element (45) is a straight radiating element.

9. The antenna device according to any preceding claim, wherein said second element (46, 46', 46'') is a radiating element selected from a group consisting of a straight radiating element, a helical radiating element, a tubular radiating element and a meandering radiating element.

10. The antenna device according to any preceding claim, wherein said first (45) and second (46, 46', 46'') elements have radiating portions of essentially equal axial lengths.

11. The antenna device according to any of claims 1-9, wherein the ratio between the axial lengths of radiating portions of said first (45) and second (46, 46', 46'') elements being essentially 2:1.

12. The antenna device according to any preceding claim, further including a radiating second structure (5) including at least one radiating element having at least a partially essentially cylindrical configuration.

13. The antenna device according to any preceding claim, further including a radiating second structure (5) including at least one radiating element selected from a group consisting of a radiator including a helical shape and a radiator including a meander shape.

14. The antenna device according to claim 12 or 13, wherein the second structure (5) includes an opening through which the first structure (41) is slidably arranged.

15. The antenna device according to any preceding claim, wherein the first radiating structure (41) has a cross section with an outer shape selected from a group consisting of an oval, a triangle, a square and a rectangle, and being arranged to be guided by a guiding means of corresponding cross section provided in/on the radio communication device.

16. The antenna device according to any preceding claim, wherein the first structure includes at least one further radiating element at least partially co-extending with the first radiating element (45), for operation in further frequency band (-s).

17. A radio communication device comprising a housing, a user interface and receiving and/or transmitting circuits connected to an antenna device,

c h a r a c t e r i s e d i n that

- it includes an antenna device (3) according to any of claims 1-16.

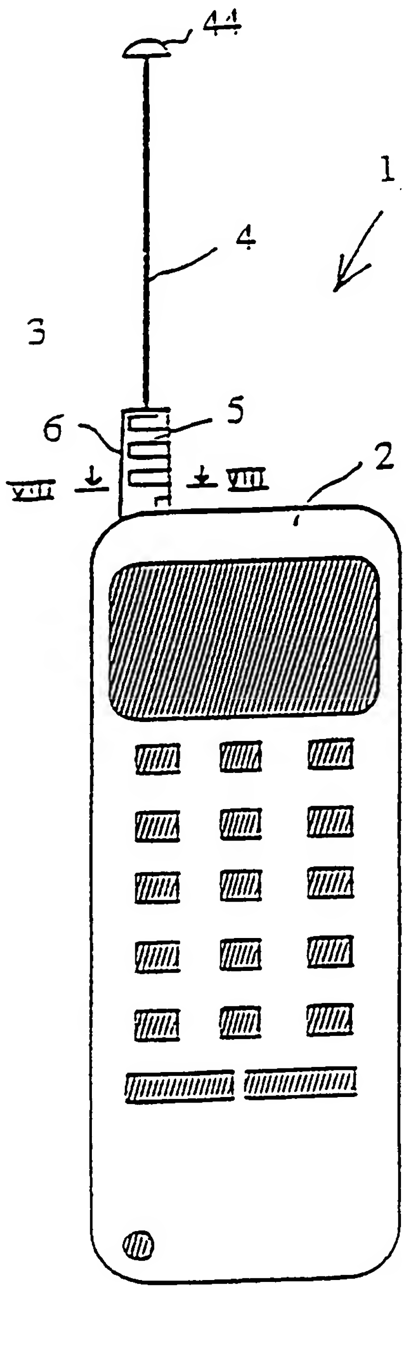


Fig. 1

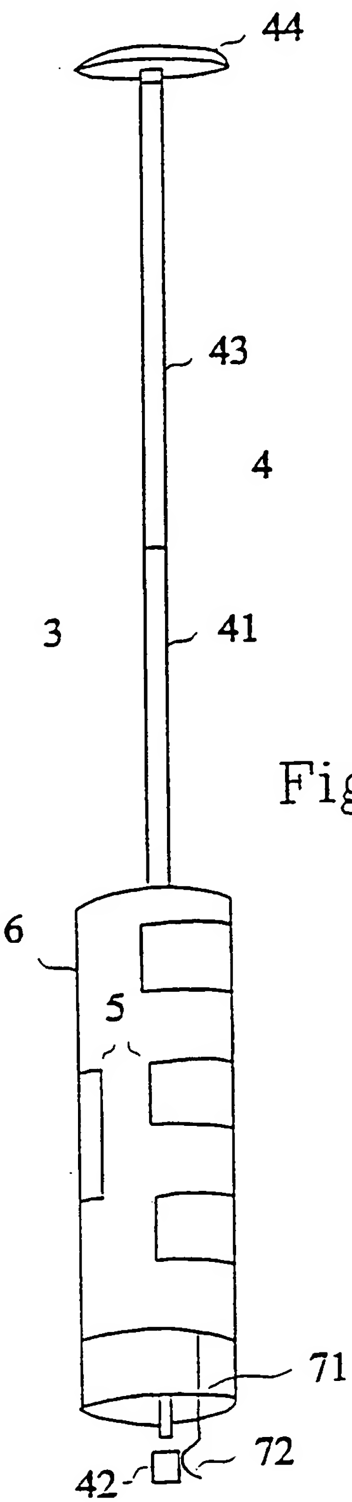


Fig. 2

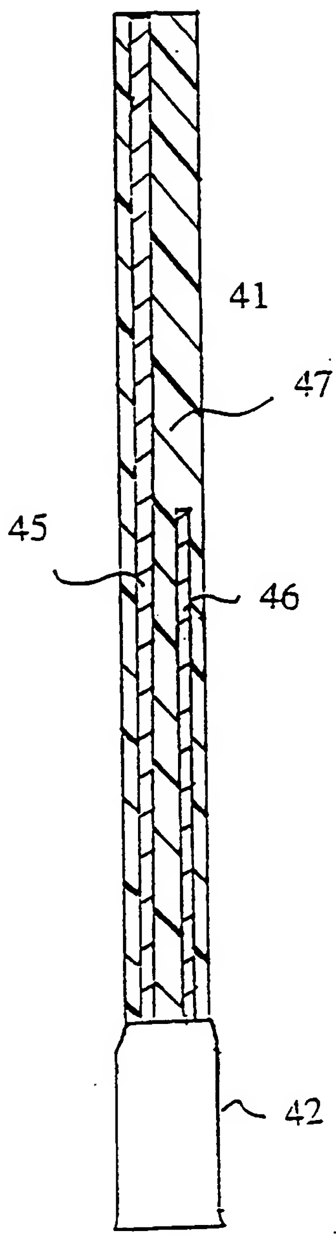


Fig. 3

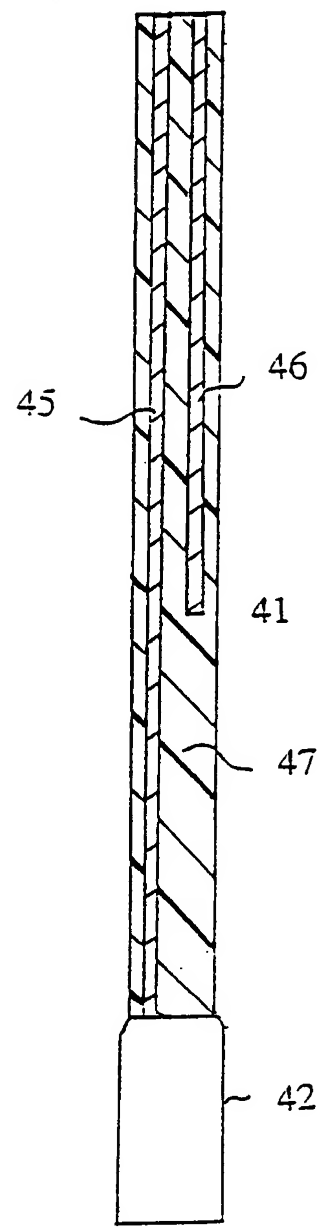


Fig. 4

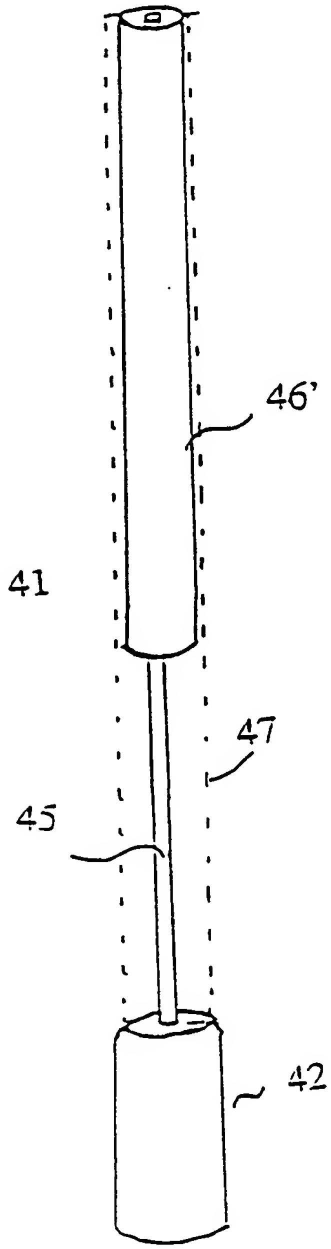


Fig. 5

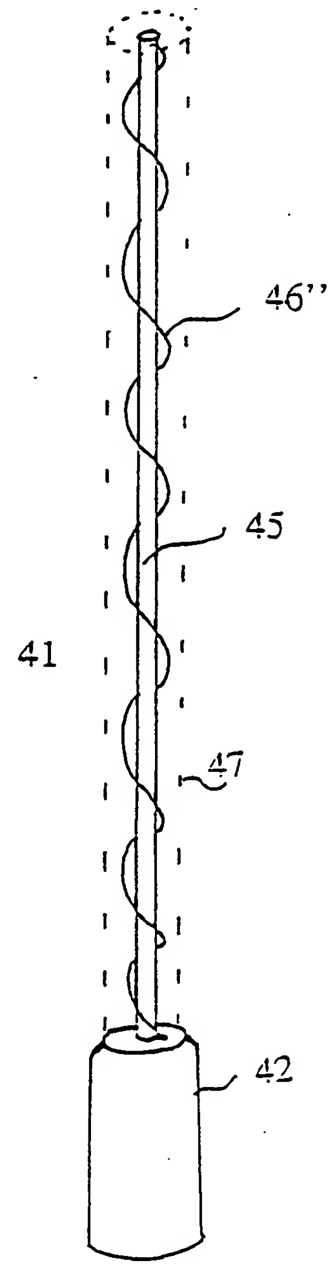


Fig. 6

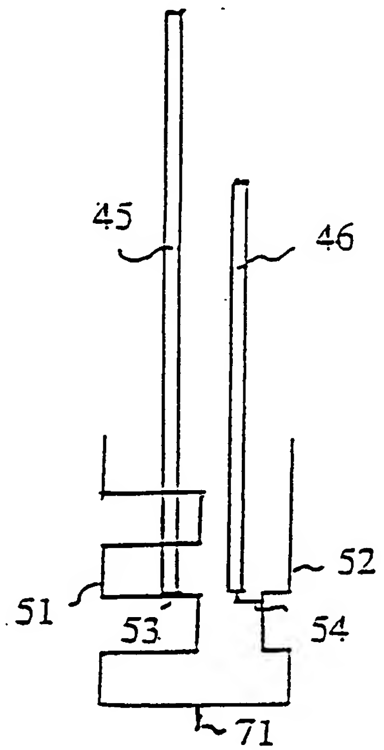


Fig. 7

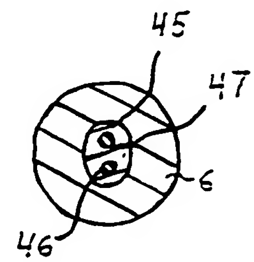


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01542

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 1/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5907307 A (P.F. BICKERT ET AL), 25 May 1999 (25.05.99), column 15, line 54 - column 18, line 11, figure 5d	1,2
A		3-17
	--	
A	US 3541567 A (R.J. FRANCIS ET AL), 17 November 1970 (17.11.70), the whole document	1-17
	--	
A	US 4138681 A (A.L. DAVIDSON ET AL), 6 February 1979 (06.02.79)	1-17
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 November 2000	20 -11- 2000

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Sven-Erik Bergdahl / MRo Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01542

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9749141 A1 (ALLGON AB), 24 December 1997 (24.12.97), the whole document -- --------	1-17

US	5907307	A	25/05/99	AT	192608	T	15/05/00
				AU	709954	B	09/09/99
				AU	4325896	A	24/07/96
				CA	2139682	A	06/07/96
				CA	2209019	A	11/07/96
				CN	1173949	A	18/02/98
				DE	69608092	D	00/00/00
				EP	0801820	A,B	22/10/97
				JP	10512407	T	24/11/98
				WO	9621254	A	11/07/96
US	3541567	A	17/11/70	NONE			
US	4138681	A	06/02/79	CA	1089091	A	04/11/80
WO	9749141	A1	24/12/97	AU	3280897	A	07/01/98
				EP	0904611	A	31/03/99
				SE	509638	C	15/02/99
				SE	9602387	A	16/12/97
				US	6069592	A	30/05/00